

Summary

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Methodological News features articles and developments relating to work done within the Methodology division. This issue contains three articles:

- Developing an Optimisation-based Tool for Interviewer Workload Allocation
- Research into a Discrete Calibration Approach for Assisting Analysts Account for Linkage Error
- Cost-effective Enumeration of Small Samples

Developing an Optimisation-based Tool for Interviewer Workload Allocation

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Household surveys are known to be a large expense for national statistical offices due to the cost of in-field interviews. Although the ABS offers online options for many household surveys, there still remain a large number of dwellings that require in-field interviewing or data collected over the phone by field interviewers. Intelligently and efficiently assigning sample to field interviewers is one task which may be used to reduce the cost of these surveys. We have been working to develop a new optimisation-based tool which offers efficiencies in the process of assigning in-field sample to interviewers.

The new workload allocation tool uses multiple stages of optimisation to automatically allocate selected dwellings from multiple surveys to interviewers subject to employment and operational constraints. The tool encompasses splitting surveys with long enumeration period into monthly chunks of work, time prediction, optimisation and visualisation and manipulation of allocations.

At the heart of the tool is mixed integer programming, and a unique spin on a classical assignment problem to fit the ABS case. The objective of each mixed integer program is to assign all selected dwellings to interviewers such that the total cost of the field interviewing for a month is minimised and all business and employment conditions are met.

The mathematical development of the tool is now complete and is undergoing testing.

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Research into a Discrete Calibration Approach for Assisting Analysts Account for Linkage Error

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We are undertaking research into a new method, known as discrete calibration, which modifies link weights produced by a probabilistic data linkage method such as Fellegi and Sunter (1969) for analysis purposes. The goal is to enable analysts of linked datasets to better capture linkage uncertainty in their statistical inferences and reduce statistical bias. In the future, analysts of linked data could obtain model inferences by simply carrying out a weighted regression using the modified weights produced by discrete calibration. At this stage this is purely a research project to determine the statistical feasibility of this method and to evaluate it against other methods in the literature.

The discrete calibration approach will not be a replacement for existing data linkage methods - rather, will aid in the analysis or quality assessment of linked data.

The discrete calibration approach obtains suitably modified link weights by calibrating the joint distribution of analytical variables on the linked dataset to their marginal distributions on the individual datasets. By doing so, we can quantify the linkage uncertainty that is inherent in the linkage process, which can be incorporated in analyses and inferences. Our research has evaluated how the performance of discrete calibration relates to initial linkage accuracy, and the improvements that these calibrated weights provide over the raw match scores (obtained from Fellegi-Sunter probabilistic linking) for quality assuring links and for the analysis of linked data. For further details, the paper titled "A Discrete Calibration Approach to Improve Data Linkage", which was presented at the March 2019 meeting of the Methodology Advisory Committee, is available on request.

Future research work will involve:

1. generalising the method to partially overlapping datasets;
2. if possible, obtaining a mathematical proof that the discrete calibration method leads to a reduction in the bias and variance of model estimates compared to standardised Fellegi-Sunter match scores or un-weighted single best links;
3. carrying out a design based simulation to evaluate the approach against other approaches; and
4. providing empirical evidence for the size of the impact on estimates from a range of different models applied to test data.

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Cost-effective Enumeration of Small Samples

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The ABS have developed an approach that will achieve efficiencies in field work for social surveys while maintaining data quality.

Enumerating a national household survey with the same sample spread over several years rather than in a single year allows flexibility in statistical outputs, including more timely publication of some estimates. However, this can lead to increased collection costs if the sample in each year is broadly dispersed geographically. Essentially this is equivalent to running several national surveys with small samples and, due to the interviewer and travel costs, the collection cost per responding household is higher than if the full survey had been conducted in a single year.

If sample in a particular area can be enumerated within the same year, these costs can be reduced significantly as the recruitment, training and management of an interviewer for that area only needs to be done once, not repeatedly for multiple years. Travel from the interviewers' homes to sampled areas can also be done in fewer journeys, rather than returning to nearby areas in multiple years.

After considering several alternatives, we chose an approach that ensures that selected sample that lies in the same SA4 (as defined in the Australian Statistical Geography Standard) is enumerated in the same year. To achieve this, we group all of the SA4s in the country into segments and select a sample from a different segment each year. By defining the segments as groups of pre-defined geographical areas, we are able to select sample each year using the most up to date sample frame available. We have designed the segments to be balanced (with respect to some key data items) in a way that ensures samples each year are selected from a segment that is nationally representative. We also balance the segments for states and parts-of-state (metropolitan and rest of state). This requires grouping SA3s rather than SA4s in some parts-of-state that have a small number of SA4s. The effective balancing of segments to ensure they are representative nationally has been confirmed by analysis of past survey data and Census data.

This method has been reviewed from practical and theoretical perspectives by internal and external advisory bodies. This advice has helped us to develop suitable selection and estimation methods, giving us confidence that this approach will give substantial efficiency gains in the field while maintaining data quality.

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About this Release

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